Foundational Approaches to Concussion Management

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Concussions are a form of traumatic brain injury and are widespread in the world of athletics, as well as in everyday life. Knowledge about the physiology and the anatomy of affected brain regions continue to be in flux researchers seek to understand its etiology and evolution.

There are many ideas concerning the treat and management of concussions, but all paradigms agree upon two fundamental tenets: 1) concussion management requires a multidisciplinary approach using a team of knowledgeable practitioners and, 2) in the earlier stages after a concussion a second concussion can lead to secondary impact syndrome, characterized by a chronic inflammatory and an increased risk of additional brain cell death.[1]

Naturopathic doctors have a diversity of treatment options that are well supported by current research and remembering the foundations of health, including nutrition, exercise, and sleep, should be in tandem with, or proceed, a supplemental approach to concussion management.

One commonly belief is that a concussion is a bruise to the brain. This is a simplistic view of a complex biological reality. The neurobiological ramifications of a head injury lie in axonal shearing.[2] The connective tissue of the meninges are shorn apart, and this damaged tissue releases reactive oxygen species (ROS). The sudden release of ROS results in cell death including cells forming the Blood-Brain Barrier (BBB). Increased permeability of the BBB allows ions, namely potassium, chloride, and sodium, to leek through causing the brain to swell.[3] Normally lactate, during oxygen sufficiency, is used for energy production intermediates, but brain hypoxia, from a concussion leads to rising lactate levels and an increase in cell death.[4]

Usually, cell death triggers a healthy immune response to clean up cellular debris. Following a concussion, depending upon the health of the patient, an inflammatory cascade can help repair the injured tissue. However, the enhanced immune response can, when the patient is not appropriately managed, result in the deposition of beta-amyloid plaque and over time contribute to age-related neurodegeneration. At the neuronal level, there is an influx of calcium into the cells and an outflux of potassium. This results in blood vessel vasoconstriction and to the reduced oxygen carrying capacity of blood (due to osmotic pull). Reduction of oxygen leaves the brain with an energy crisis. During this phase of hypoxia, the excitatory neurotransmitter glutamate is released leading to neuronal excitotoxicity which continues the proliferation of cell death.[5]

Our brains have a great capacity to heal and are blessed with many pathways that seek to bring back health. Brain-derived neurotrophic factor (BDNF) is paramount to the regeneration of brain tissue post-concussion. BDNF production is enhanced by exercise, sleep, coffee, and some supplements. Low levels of BDNF are pathognomonic for brain injury and will likely become a surrogate measure for concussion severity in the future.[6]

In recent years several tools have been developed to describe the brain's metabolic state.

Diagnostic imaging does not show metabolic damage but is critical to can rule out hemorrhage and skull fracture. Knowledge of metabolic damage helps with diagnosing the stage of injury and the timing of treatments. Unfortunately there is rarely baseline data when working with concussed patients (what was their normal before becoming injured?). And, an unfortunate all-too-common occurrence is the return of athletes and general population to sport or work or other activities of daily living before they have sufficiently healed.[7, 8]

Thus, a good medical history during initial intake and the presence of a knowledgeable third party are important to developing a more complete medical and personal history. A careful understanding of your patient's lifestyle, habits, sleep hygiene, dietary decisions, and stress tolerance can aid in patient assessment treatment choices. Pay particular attention to the whole person during intake since the brain is a central administrator . Determine the scope of injury, and changes in function, across the life of the patient will highlight features that may have been missed by the patient themselves.

Given our current understanding of concussions one treatment goal is to reduce inflammation and brain function regeneration.

Exercise

Berlin Concussion in Sport Group Consensus statement 2017 outlines acute management recommendations with back to play recommendations for concussions in sport. This is an excellent tool for practitioners to ensure their patients will re-enter their sport/

activity safely.[9] A brief summary of their major recommendations include: 1) using SCAT5 (Sports Concussion Assessment Tool 5th Edition) and CRT5 (Concussion Recognition Tool 5th Edition) as foundational assessment for concussions in all sports[10-12] at least 10 minutes should be allocated for an off-field evaluation in a distraction-free environment, and 3) make it a priority to educate and the entire allied healthcare team, including nurses, emergency medical technicians, primary care and emergency medicine physicians.

Often the lingering issue of elevated heart rate and low heart rate variability indicate autonomic dysfunction and the need for nervous system retraining.[18] Without retaining this system patients will have elevated levels of cytokines and may experience significant anxiety, depression, and other parasympathetically-mediated symptoms that can persist for weeks, months or even years.[12]

The Buffalo Concussion Treadmill Test (BCTT)[13] is one method to assess the readiness and to safely return athletes and citizens back to sports and vigorous activity who have been symptomatic with activity. The purpose of the BCTT is to:

• To investigate exercise tolerance in patients with post-concussive symptoms (PCS) lasting more than three weeks.

• To help establish appropriate levels of exercise to aid in return to play for concussed athletes and assist in treatment protocols.

• To aid in differentiating between possible diagnoses for concussive symptoms (cervicogenic injury) and etiology of the concussion.

• To identify physiological variables associated with exacerbation of symptoms, and the patient's level of recovery.

If you do not feel comfortable or have the facilities to conduct these evaluations, patients should be referred to an appropriately trained allied healthcare professional.

Sleep

Brain repair occurs during sleep, thus a sleep diary and sleep history, past and present, can help to diagnose problems. A sleep study can assess and diagnose brain wave pattern changes that affect both the sleep state and the wake state. The input of a sleep partner or parent can also be helpful.

Research shows that melatonin can improve sleep disturbances in some patients.[14]

Melatonin is a darkness signal to the suprachiasmatic nucleus, and a sleep regulator, which initially signals readiness for the onset of sleep.[15] Melatonin is also a powerful antioxidant that can help with brain repair.[16] Staying asleep is usually associated with factors other than just melatonin - sleep in an active process and not merely being unconscious.[17]

Although some debate surrounds melatonin dosing, a recent research trial with athletes suggests using a moderate dose to mimic the body's natural light/dark response. The study used a dose of 2mg at bedtime.[18]

Nutrition

Poor nutrition and the consumption of ultra-processed foods can one of the factors in systemic inflammation seen in clinical practice. Assessing a concussed patient's diet and suggesting the consumption of whole foods will help to nourish them.[19]

One of the better ways to reduce inflammation is an anti-inflammatory diet or a ketogenic diet.[20, 21] When making nutritional recommendations do not to overwhelm the patient with a whole new way of eating without appropriate, complete support. Assess the patient's ability to add and subtract new foods and culinary habits. Starting with an anti-inflammatory diet and teaching the principles of healthy eating, before going to a wholly ketogenic diet, dovetails well with a foundational approach to healing.

It is important when discussing nutrition with your patients, to remember that autonomic dysregulation post-TBI can lead to a predominantly sympathetic state and thus adversely impact on the digestive system. Autonomic dysregulation has been associated with IBS symptoms and having some gastrointestinal issues are widespread in concussion patients.[22, 23] Botanical bitters are a great tool to support celiac plexus blood flow and improve post-concussion gastrointestinal upset.[24]

Supplementation

Laying a solid foundation of nutrition, exercise, and sleep hygiene are first-line in treating concussed patients. These lifestyle interventions are whole-body system-level medicine that no supplement can duplicate.

There are many supplements with research for concussion management, and some of that research is detailed here:

Curcumin

Curcumin is a pluripotent antioxidant that affects many body systems especially those that are inflamed or that cause inflammation. Curcumin can protection to the blood-brain barrier, brain metabolism and mitochondria, and aid in synaptic plasticity. The critical clinical issue is absorption; delivery systems that will work for a concussed patient. Recommended dose of curcuminoids is 350 to 2,000mg per dose up to 4 times per day depending upon gastrointestinal tolerance.[25, 26]

Creatine

Creatine is involved in ADP-ATP recycling. Creatine has been shown to boost brain energy, reduce post-traumatic amnesia, and improved recovery outcomes including decrease duration of treatment and an increase in post-concussion cognition.

However, the studies into brain creatine levels show concentration is variable and not constant – it seems that tissue type, amount of activity, degree of vasculature affected, and type of traumatic brain injury can effective levels.[27] There is clearly a need for more research, as current findings indicate that brain trauma may affect neural creatine concentration, and that the concentration postinjury is related to cognitive performance. The recommended dose is 5g per day with no loading phase required.[28]

Fish Oil

Fish oil has multiple brain benefits. It provides raw materials that not only build new brain tissues but also combat inflammation. Both EPA and DHA in fish oil have neuroprotective effects, attenuate neuronal glutamate excitotoxicity, and assist brain metabolism in post-trauma clean-up and repair. The recommended dose is 1.5-3.0 g DHA twice daily for 30 days with additional EPA of 500 to 2000 mg per day as an anti-inflammatory.[29, 30]

Additional supplemental interventions with research, include: choline,[31] acetyl-l-carnitine,[32] glutathione,[33] vitamin B12,[34] and vitamin C.[35]

Summary

Taking a foundational approach to concussion management by placing emphasis on nutrition, appropriate exercise, and sleep hygiene reflect the vector of current research and clinical guidelines. Incidentally, the foundational approach is one of the fundamental frameworks of naturopathic medicine and is well suited for an alliance with the conventional paradigm. While it is important to supplement when necessary, to give the patient the best chances at cultivating recovery start with whole-body medicine and build a treatment around the individual.

About the Authors

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